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Digitalizing Procurement Processes: An Online Automated Auction System: Design, Implementation and Evaluation

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ABSTRACT

This research titled addresses the inefficiencies and lack of transparency associated with the manual auctioning process of surplus government assets. The system was developed as a web-based platform using HTML, CSS, PHP, and MySQL, aiming to streamline the auctioning process, enhance public participation, and promote accountability. Key features of the system include user registration, real-time bidding, secure payment processing, and an administrative dashboard for auction management. Through an extensive review of online auction systems and their application in government agencies, the project emphasizes the importance of transparency, accountability, and security in auction platforms. System testing demonstrated the platform's effectiveness in meeting its objectives, providing a user-friendly and efficient alternative to traditional methods. This solution significantly improves the auctioning process, fostering public trust and ensuring better asset disposal management. The project also provides recommendations for continuous monitoring, user training, and the integration of advanced features to enhance the system's functionality and adaptability in the future.

Keywords: Transparency; Auction; Dashboard; Application; Administrative; Accountability; Streamline; Registration; Integration; Training.

1. Introduction

The advent of the internet fundamentally revolutionized commerce and asset exchange, with the online auction system standing out as one of the most significant innovations in e-commerce (Cassady, 2020). These digital platforms enable competitive bidding for goods and services, often resulting in better pricing for sellers and good value for buyers. This model has gained global prominence, extending from retail sectors to public sector asset management. According to Prasad et al. (2025) online auction system is designed to enhance user experience, optimize bidding strategies, and ensure fair and efficient transactions.

In government sectors, auctions are commonly used to dispose of surplus or outdated assets such as vehicles, equipment, or property. Historically, these processes have been conducted through physical, traditional means, which inherently involve logistical challenges, a limited audience, and restricted accessibility (Smith & Jones, 2022). Recognizing these limitations, many global government agencies, such as the U.S. General Services Administration (GSA), have successfully shifted toward web-based systems to improve efficiency and ensure transparency in asset disposal (Public Sector Modernization Report, 2023). This study focuses on implementing a similar modernization to digitalize procurement processes to replace outdated auction methods.

Manual and paper-based system for disposing of surplus government assets has led to critical inefficiencies and management challenges, including:

- **Limited Participation:** Auctions are subject to geographical constraints, requiring physical presence, which restricts the potential bidding pool and limits the maximum achievable revenue (Cassady, 2020).

- **Lack of Transparency and Accountability:** Manual records are prone to human error, potential manipulation, and make auditing difficult, leading to a lack of public trust in the fairness of the disposal process (Smith & Jones, 2022).

- **Operational Inefficiencies:** The process is time-consuming and involves administrative delays due to the paper-based nature of bid submission, verification, and payment handling.

These problems collectively hinder the Ministry's ability to maximize revenue from asset disposal and maintain public confidence, necessitating a shift to an automated, web-based solution. The primary aim of this project is to design and implement a robust, web-based online auction system for efficient procurement and auction, to streamline the process, significantly improve transparency, increase overall efficiency, and ensure broader public participation.

1.1. Objectives

The following specific objectives guided the system's development:

1. **Technology Implementation:** Develop the platform using contemporary web technologies, including HTML, CSS, PHP, and MySQL.

2. **Real-Time Engagement:** Design the system to allow users to place real-time bids and receive real-time notifications regarding their bid status.

3. **Secure Transactions:** Integrate a secure payment gateway for handling financial transactions, including bid deposits and final payments.

4. **Promote Transparency:** Implement features that ensure transparency and accountability by tracking and logging all auction activities.

5. **Administrative Control:** Provide comprehensive administrative tools for Ministry staff to effectively manage auction listings, user accounts, and generate detailed performance and revenue reports.

The implementation of this system is justified by the potential for Increased Participation (removing geographical barriers), Revenue Maximization (due to increased competition), Improved Transparency & Accountability, and Improved Record-Keeping (Public Sector Modernization Report, 2023).The scope of this study is strictly limited to the design and implementation of the functional web application and database, focusing on the core modules of User Authentication, Auction Management, and Reporting. It provides a blueprint for replacing the manual asset disposal procurement processes.

2. Review of Related Literature

The concept of auctions, an ancient form of commerce, was fundamentally revolutionized by the internet in the 1990s. The launch of platforms like eBay (1995) popularized the model, transitioning the transaction from a geographically constrained event to an accessible global marketplace (Turban et al., 2021). This digital transformation brought numerous advantages over traditional, physical auctions, primarily by significantly increasing market reach and competition.

- **Public Sector Adoption:** Governments worldwide recognized the efficiency gains, and agencies such as the U.S. General Services Administration (GSA) now use online platforms to improve the efficiency and transparency of public asset disposal. This shift is critical for public sector organizations seeking to maximize revenue from surplus assets while demonstrating fiscal responsibility and openness (Government e-Procurement Journal, 2019).

- **Benefits:** The literature highlights that online auctions enable increased participation, which leads to revenue maximization due to greater competition, and improved record-keeping, replacing error-prone manual methods. Furthermore, the system allows for the inclusion of automated bidding features, which further enhances user convenience and market efficiency.

Figure 1. Key Security Components of the Online Auction System

2.1. Critical Security Measures in Online Auction Platforms

Given that online auction systems involve sensitive user credentials and financial transactions, robust security is paramount. The literature identifies several essential measures required to maintain platform integrity and user trust, mitigating common threats like phishing and data breaches (Kashyap & Sharma, 2020).

- **Data Encryption:** Key security measures include data encryption using protocols like SSL/TLS (Secure Sockets Layer/Transport Layer Security). This is crucial for securing data transmitted between the user's browser and the server, particularly during registration, login, and bidding (Kashyap & Sharma, 2020).

- **Secure Payment Gateways:** The system must integrate secure payment gateways to ensure that all financial transactions (deposits, final payments) are processed through trusted and compliant external services, protecting users from financial fraud.

- **Multi-Factor Authentication (MFA):** Implementing Multi-Factor Authentication (MFA) adds an essential layer of security by requiring users to provide two or more verification factors to gain access, thereby preventing unauthorized access and protecting sensitive data.

2.2. Enhancing Transparency and Accountability

For a public sector system, transparency and accountability are critical design principles to ensure public confidence in the fair disposal of government assets (Government e-Procurement Journal, 2019). Evolutionary computation is being used to improve software as claimed by (Ugah et al., 2025).

- **Real-Time Visibility:** Transparency is primarily achieved through features that allow bidders to view current bid information. This includes displaying the current highest bid and, in many cases, a history of recent bids, ensuring the process is open and competitive.

- **Activity Logs and Auditing:** To prevent bid manipulation and foster public trust, the system must utilize detailed activity logs. These logs serve as an unalterable audit trail, recording every significant user action, including login attempts, bid placements, modifications, and system events. The availability of these records ensures that the Ministry can effectively demonstrate and prove the legitimacy of every auction outcome. The use of advanced ledger technologies, such as Blockchain, is also being explored in the literature to further enhance accountability and traceability in auction systems (Turban et al., 2021).

3. Materials and Methods

The development of the online auction system adopted the Agile development methodology. Agile is an iterative and incremental approach to software development, emphasizing flexibility, continuous delivery, and collaboration among self-organizing teams (Sommerville, 2021).

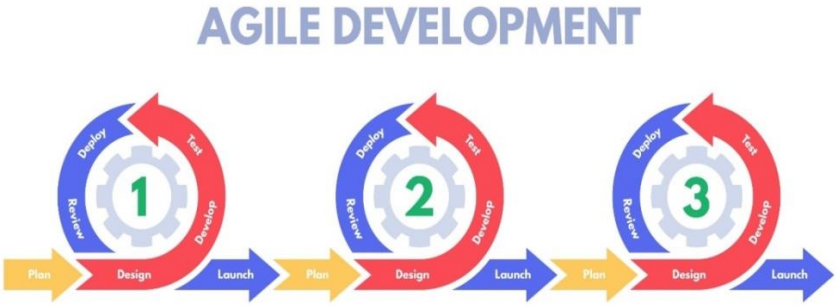

Figure 2. Agile Methodology Flow for the auction system

4. Data Gathering Techniques

1) Interviews

In view to investigation, workers at the ministry of works who are potential users of the proposed system were interviewed. This method yields the most profitable result as it is obtained by physical contacts; hence a firsthand knowledge of the various processes involved is obtained by speaking to the operator of the system. The essential element of the interview is obtained directly and in a short time than when other methods are employed since the interviewer is with the interviewed. This immediate feedback gives the opportunity to ask ambiguous questions and hence, obtain detailed responses.

2) Observation

The observation is another fact-finding technique that was adopted, which I paid close attention to the day to day activities which provided another perspective and better understanding of procedures.

3) Internet

Information such as background information, technical materials and news about the Employee appraisal trends and development which were gathered to publish this topic were obtained in sources like newspapers, and journals.

4.1. Analysis of the Existing System (Manual Process)

A thorough analysis of the existing manual system for asset disposal at the Ministry of Works and Transportation Nigeria, revealed significant shortcomings that necessitated the development of a new digital solution.

Key Problems Identified:

Table 1. Key problems identified in the existing system auction system

Problem	Consequence of Manual System
Limited Participation	Physical presence restricts the bidding pool, leading to lower competition and sub-optimal revenue generation (Cassady, 2020).
Lack of Transparency	Manual record-keeping is susceptible to human error and potential manipulation. The absence of a clear, verifiable audit trail undermines public trust and accountability (Smith & Jones, 2022).
Time-Consuming and Inefficient	The protracted process, from registration to record updates, is administratively burdensome, leading to significant delays and tying up valuable human resources.
Geographical Constraints	Participation is strictly limited by location, excluding potential buyers from other regions.

4.2. Proposed System Architecture (New System)

The proposed online auction system is designed based on a robust three-tier client-server model. This architectural pattern, highly recommended for web applications, enhances scalability, maintainability, and security by separating the different logical components of the application (O'Brien & Marakas 2020).

Table 2. Three-tier client-server model for the auction system

Tier	Function	Technologies Used in Project
1. Presentation Layer (Client-Side Interface)	Responsible for the **User Interface (UI)**, displaying information, and capturing user input.	HTML, CSS, JavaScript
2. Application Layer (Business Logic)	Contains the core business logic, processing user requests, enforcing application rules (e.g., validating bids, authentication), and interacting with the database.	PHP
3. Database Layer (Data Storage Layer)	Responsible for the **persistent storage and retrieval** of all system data, including user profiles, bid history, and administrative logs.	MySQL

4.3. System Justification and Benefits

The transition from a manual to an online auction system is strongly justified by the tangible benefits it offers to the Ministry and the public:

- **Increased Participation:** Removing geographical barriers attracts a wider pool of bidders, leading to more competitive bidding and potentially higher sale prices for assets.
- **Revenue Maximization:** Greater competition directly translates to an increased likelihood of selling assets at their optimal market value, thereby maximizing revenue generation for the Ministry (Public Sector Modernization Report, 2023).

- **Enhanced Transparency & Accountability:** Automated record-keeping, real-time bid displays, and comprehensive activity logs ensure the process is transparent and auditable, fostering greater public trust.
- **Improved Record-Keeping:** All data is stored digitally in a centralized database, reducing errors, improving data integrity, and simplifying retrieval for reporting and auditing purposes.
- **Efficiency and Cost Reduction:** Automation reduces the administrative burden, processing time, and human resource allocation previously required for manual auctions.

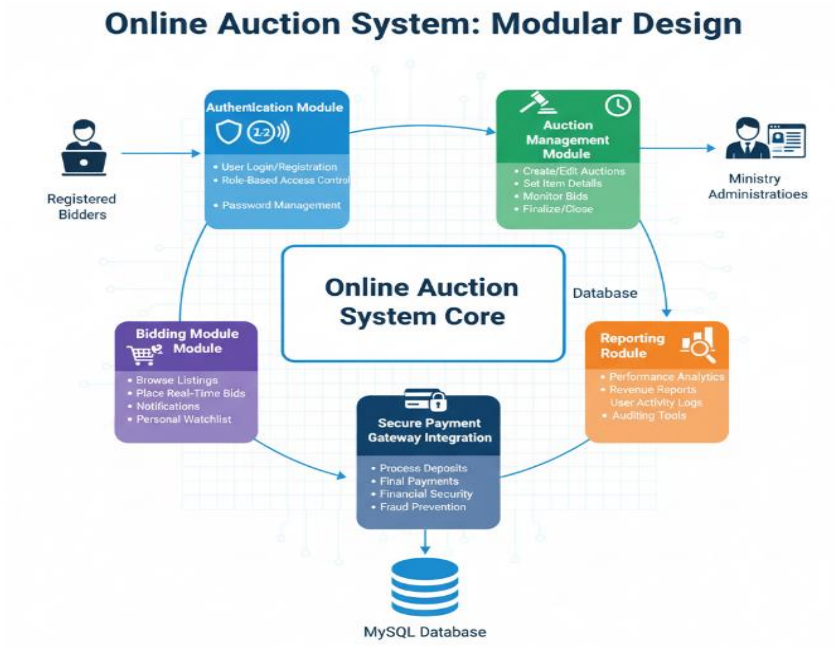

Figure 3. Modular Design of the Online Auction System

5. System Design

The system design was driven by a set of clear objectives aimed at creating a highly functional, secure, and user-centric online auction platform. These objectives directly address the problems identified in the manual system and leverage the capabilities of modern web technologies (O'Brien & Marakas, 2020).

- **User-Friendly Platform:** The system prioritizes an intuitive and accessible user interface (UI) and user experience (UX) for all stakeholders, including both bidders and administrators. This involves clear navigation, easy-to-understand forms, and responsive design to ensure usability across various devices.
- **Real-Time Bidding Capability:** A core objective was to enable dynamic and real-time bidding, allowing users to place bids instantly and receive immediate feedback, such as outbid notifications. This enhances engagement and fosters a competitive environment.
- **Secure Payment Gateway Integration:** To facilitate reliable and safe financial transactions, the system was designed to integrate a secure and compliant payment gateway. This ensures the protection of sensitive financial data and supports various payment methods for bidder convenience (Kashyap & Sharma, 2020).
- **Comprehensive Administrative Tools:** The design includes a robust suite of tools for Ministry administrators to effectively manage all aspects of the auction process.

- **Data Integrity and Security:** Beyond payment security, the overall system design incorporates measures to protect all stored data from unauthorized access, corruption, or loss, aligning with the principles discussed in the literature review.

- **Scalability and Performance:** The architecture was designed to be scalable, capable of handling an increasing number of users and concurrent auctions without compromising performance or stability (Sommerville, 2021).

5.1. Program Modules

To ensure a modular, maintainable, and scalable system, the online auction platform was logically divided into several distinct, yet interconnected, program modules. Each module is responsible for a specific set of functionalities.

Table 3. Program Modules for the auction system

Module	Purpose and Key Features	Access Control Feature
1. Authentication Module	Secures the system and manages access (Registration, Login, Password Management).	**Role-Based Access Control (RBAC):** Differentiates permissions for bidders and administrators, ensuring system security (O'Brien & Marakas, 2020).
2. Auction Management Module	Core control for administrators over the auction lifecycle (Creation, Details Management, Status Control, Bid Monitoring, Closure).	Administrator access only.
3. Bidding Module	Enables user participation (Browse Auctions, Place Bids, Bid Monitoring, Watchlist).	Registered user/bidder access only.
4. Reporting Module	Provides administrators with actionable data (Auction Performance Reports, Revenue Reports, User Activity Reports, Customizable Reports).	Administrator access only; crucial for auditing and accountability.

6. System Implementation

For the initial conceptual deployment of the new online auction system, the Direct Approach (also known as the "Big-Bang" approach) was adopted as the primary implementation strategy for system replacement (Laudon & Laudon, 2024).

Direct Approach Explained:

This strategy involves immediately discontinuing the old manual system and simultaneously launching the new online system. There is no period of parallel operation; the transition is abrupt.

Rationale for Selection:

- **Quick Transition:** Ensures a rapid move away from the inefficient manual methods.
- **Cost-Effectiveness (Short-Term):** Avoids the expenses associated with running two systems concurrently.
- **Simplicity (Management):** Eliminates the complexities of maintaining and synchronizing two systems.

Note on Strategy: While the initial intent was for a Direct Approach, the high-risk nature of abruptly switching the core asset disposal mechanism often leads practitioners to recommend a less risky strategy, such as the Parallel Changeover, for the actual deployment phase to ensure business continuity (Laudon & Laudon, 2024).

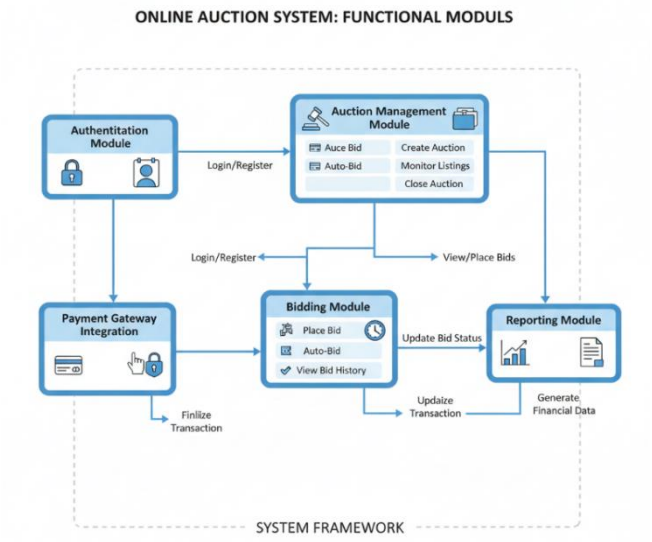

Figure 4. Online Auction System Functional Modules and Interaction for the auction system

6.1. System Implementation Environment

System implementation involves setting up the technical environment and physically installing the designed and developed software. This phase ensures the system is ready for testing and final deployment.

- **Software and Hardware Requirements:** The system requires a standard Web Server Environment (like Apache or Nginx) capable of running PHP. The database is powered by MySQL. On the client side, a modern web browser and a stable internet connection are required.
- **Database Setup:** The database schema, designed in Chapter Three, was created in MySQL, involving tables for Users, Auction Items, Bids, Transactions, and System Logs. Sample data was initially populated to facilitate testing.
- **Code Deployment:** The PHP and front-end files (HTML/CSS/JavaScript) were deployed onto the web server. The application code was configured to establish a secure connection with the MySQL database.
- **Configuration:** Key system parameters, such as the administrator email addresses, payment gateway API keys, and notification settings, were configured and verified in the live environment.

6.2. Main Menu Implementation

The home page serves as the central point of access to the Online Auction System. As the default landing page, it provides users with a comprehensive interface for navigating the system. The home page was designed to offer an intuitive user experience, with clearly visible links to key features such as auction listings, bid placements, user profiles, and system support. Its design also includes sections for administrators to manage auctions, users, and reports. The implementation ensures that the home page is easy to use, offering a seamless navigation experience for both regular users and administrators, while clearly showcasing the system's functionalities.

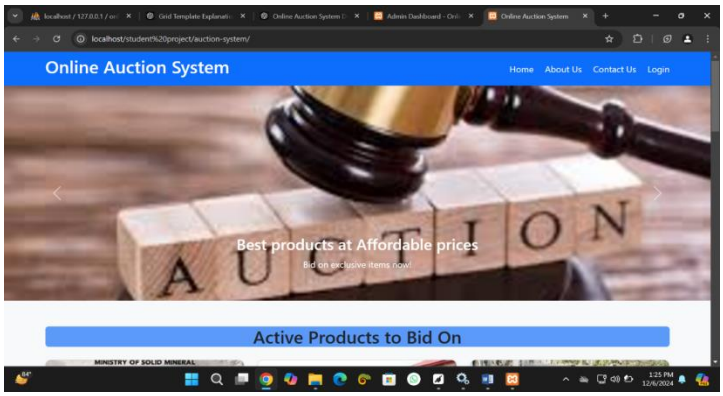

Figure 5. Home Page Implementation of the auction system

6.3. Input Implementation

The word input entails the various data supplied to the system which are processed to give out an output. The figures below show the input forms used in the implementation of the new system.

A. Registration Input Implementation

The registration input enables the users to input his or her information in other to have a password and email that he or she will be using to login into the system subsequently, this registration input design, enable the system to keep the user details.

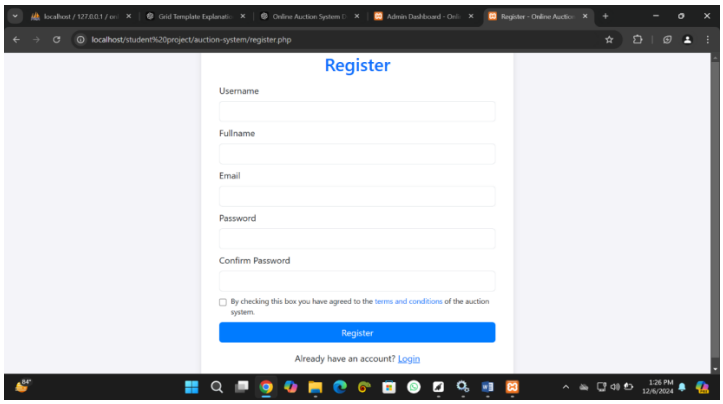

Figure 6. Registration Input Implementation of the auction system

6.4. Admin Dashboard Implementation

The Admin Dashboard page implementation provides all the activities of the user in the system

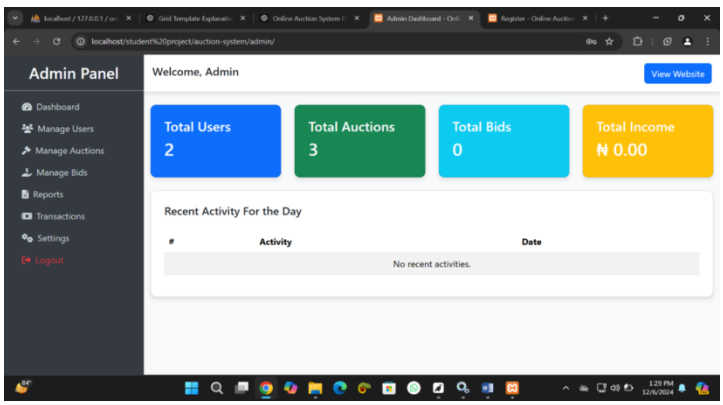

Figure 7. Admin Dashboard Implementation for the auction system

7. System Testing

Before conversion, the system underwent a rigorous testing phase to ensure it was functional, reliable, and met all the objectives outlined in section one (Sommerville, 2021).

Table 4. System Testing and results of the auction system

Testing Type	Description	Key Focus
Unit Testing	Individual components (e.g., login function, bid validation logic) were tested in isolation to ensure they performed their specific tasks correctly.	Accuracy of underlying PHP functions.
Integration Testing	Tested the interaction between different modules (e.g., Authentication passing data to Bidding) and their ability to work together as a subsystem.	Data flow and interface integrity between modules.
User Acceptance Testing (UAT)	A small group of Ministry staff and potential bidders verified that the system was user-friendly, the real-time bidding worked, and the reports were accurate, confirming operational readiness Laudon & Laudon, (2024).	Usability and fulfillment of business requirements.

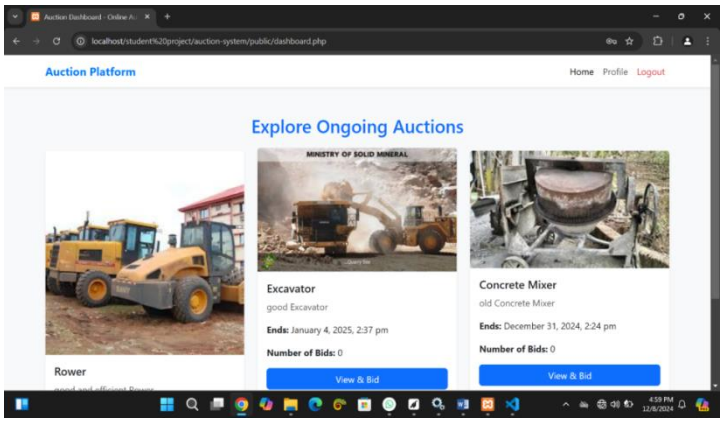

Figure 8. Auction platform Output

7.1. Changeover Procedure: Parallel Changeover

The changeover procedure dictates how the organization transitions from the old manual system to the new computerized online system. The Parallel Changeover approach was explicitly recommended for this transition.

Definition: Parallel Changeover involves operating the new computerized system and the old manual system simultaneously for a specified period (O'Brien & Marakas, 2020**)**. The new system is used to conduct real auctions alongside the manual process, where both generate identical output and records.

Rationale and Advantages:

1. **Risk Mitigation:** This is the most significant advantage. If any unforeseen errors or system failures occur in the new system, the organization can immediately rely on the old manual system, ensuring business continuity without loss of data or service disruption (Laudon & Laudon, 2024).

2. **User Confidence and Training:** Running both systems concurrently allows Ministry staff and users to gradually build user confidence and proficiency with the new interface without the pressure of total system reliance.

3. **Data Verification:** The output and results from the new online auctions can be directly compared with the traditional manual records to verify the accuracy and integrity of the new system's logic and data processing.

Execution: For a specified period (e.g., one or two auction cycles), all asset disposal activities will be processed using both methods. Once the results are consistently validated and staff proficiency is confirmed, the manual system will be formally decommissioned, leaving the online system as the sole method

8. Conclusion

The implementation of this online auction system marks a significant advancement in the auctioning process by replacing the manual system with an automated, transparent, and efficient platform, the project enhances public trust, broadens participation, and ensures better asset disposal management. The system's real-time features, coupled with secure payment processing and user-friendly navigation, demonstrate its potential to set a benchmark for similar initiatives in other government agencies.

9. Future Suggestions

The study recommends actions for long-term sustainability, including:

1) Continuous monitoring and maintenance .Regular updates and system audits should be conducted to address emerging challenges, enhance performance, and incorporate feedback from users.
2) Providing adequate training and support for staff and bidders Provide comprehensive training sessions for administrative staff and detailed user manuals for bidders to ensure efficient system operation and widespread adoption.
3) Integrating advanced features like AI-based analytics.
4) Integrating features to capture fraud detection and scam in the auction system.
5) Conducting public awareness campaigns to increase participation to increase the acceptance of the new auction system y users.

Declarations

Source of Funding

This study received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Competing Interests Statement

The authors declare that they have no competing interests related to this work.

Consent for publication

The authors declare that they consented to the publication of this study.

Authors' contributions

All the authors made an equal contribution in the Conception and design of the work, Data collection, Drafting the article, and Critical revision of the article.

Ethical Approval

Not applicable for this study.

Institutional Review Board Statement

Not applicable for this study.

Informed Consent

Not applicable for this study.

References

[1] Cassady, R. (2020). History and practice of auction systems. University of California Press, 6: 74–80.

[2] Public Sector Modernization Report (2023). Digital transformation in government asset disposal. World Governance Institute Journal, 7: 12–15.

[3] Smith, A., & Jones, B. (2022). The drawbacks of traditional paper-based systems. Journal of Administrative Efficiency, 18: 45–50.

[4] Government e-Procurement Journal (2019). The shift to digital: Transparency and governance in asset disposal. Government E-Journal Publishing, 4: 55–62.

[5] Kashyap, S., & Sharma, M. (2020). Security implementation in e-auction systems. International Journal of Computer Science and Network Security, 20: 101–106.

[6] Turban, E., King, D., Lee, J.K., Warkentin, M., & Chung, H.M. (2021). Electronic commerce: A managerial and social networks perspective. Springer Texts in Business and Economics, 14: 256–260.

[7] O'Brien, J.A., & Marakas, G.M. (2020). Management information systems. McGraw-Hill Education, 11: 230–235.

[8] Prasad, J., & Lasya, B. (2025). AI-driven auction platform: A comprehensive system for user, auction, payment and review management. International Journal of Engineering Applied Sciences and Technology, 9: 67–72. https://doi.org/10.33564/ijeast.2025.v09i11.011.

[9] Sommerville, I. (2021). Software engineering. Pearson Education, 11: 80–85.

[10] Laudon, K.C., & Laudon, J.P. (2024). Management information systems: Managing the digital firm. Pearson Education, 18: 510–515.

[11] Ugah, J.O., Aniji, I.V., Chizoba, C.E., Offiah, I., & Ajuka, G.E. (2025). AI-driven software optimization: Integrating reinforcement learning, deep learning and evolutionary computation for improved performance and reliability. Asian Journal of Applied Science and Technology, 9: 1.